CHAPTER 5
PARENTAL EXPENDITURES ON CHILDREN

BACKGROUND

Since parental spending on children is viewed as an important determinant of fertility decisions as well as the basis of welfare comparisons across families with different numbers of children and adults, there has been considerable academic interest in the estimates of the costs of raising children. Interest in this topic has not been solely academic, however. For example, to create child support policy that would attempt to maintain the same level of parental spending on children after the divorce or separation of the biological parents as before, knowledge of child spending patterns during the time when both parents lived with the children would be required.

Determining how parents devote expenditures to their children would seem to be a rather simple and straightforward exercise. First, parents would have to be asked to keep track of their expenditures. Then, parents would be asked to determine how much of each expenditure was made on behalf of their children. It is at this latter stage that problems arise because making that allocation can be difficult. In the case of some goods, the allocation of the consumption could be done with some confidence, since the purchase was made for a specific individual. The cost of a pair of shoes, for example, could be allocated to the person for whom the shoes were purchased. In the case of other goods, the spending could be allocated on the basis of a reasonable assumption or based upon information gathered in other surveys. Here, food consumption is a good example. While purchases at the grocery store are not made for individual members, it could be possible to observe the actual consumption of the meal and then allocate the cost of the meal to the individual members based upon their consumption. Or, alternatively, the allocation of the food bill could be done in proportion to the nutritional requirements of the various family members. If one member requires twice as much nutrition as another member, then it could be assumed that the first individual had consumed twice as much food.

But how should spending that is made on behalf of the whole family and not one individual be allocated? For example, how should expenditures on shelter and utilities be allocated to the children? What is a reasonable assumption to make in this situation? One approach would be to average the spending on housing and other "publicly consumed" goods across all family members. The USDA takes this direct approach in its annual estimates of parental spending.

Allocating jointly consumed goods on a per capita basis has always been controversial. Many fathers' rights groups have taken the position that child support

guidelines based upon the "average cost" of the child will overstate the "true" cost of the child to the parents. Instead of focusing on the average, these advocates suggest that a more appropriate division between the parents and the children should be based on the "marginal cost" of the children. The amount of housing or any other jointly consumed good to be attributed to the children should be the *additional* amount of housing that the parents purchase because of the presence of the children. If there are economies of scale in housing consumption, then the average cost of housing should fall with increasing family size. But, if the average cost of housing is falling, then the marginal cost associated with each additional family member should be less than the average cost.

How can the marginal housing costs of the children be estimated? One approach would be to attribute the difference in housing expenditures of parents with children and the housing expenses of childless couples with the same amount of total spending as equal to the marginal housing cost of the children. While this commonsense approach may seem appealing, economists warn that it will not capture the true marginal cost of housing due to the children. If children represent an economic cost to their parents, then the childless couple, even though they have the same total spending, will be wealthier than the parents with the children. Ignoring the effect of the increased standard of living of the childless couple on their housing expenditures will understate the true marginal housing costs attributable to the children.

If consumption is to be correctly allocated to individual family members, then both childless couples and parents with children will have to share the same economic standard of living. In other words, this question will need to be answered: "At what level of total spending is a childless couple as equally well off as a couple with one child and $30,000 of total spending?" If it is assumed that the equivalent level of total spending for the childless couple is $22,500, then the total cost of the child is $7,500 or 25 percent of the family's total spending ($7,500/$30,000 = .25). To allocate individual commodity categories such as housing to the children, the difference in housing expenditures of couples with a child and $30,000 of total spending would be attributed to childless couples with $22,500 of total spending. Given that purchases of individual commodities will need to add up to total spending, using this procedure for each commodity category should yield a total spending on a child equal to $7,500, the difference between the total spending of families with children and childless couples who have the same standard of living.

But what is the best way to determine when families of differing composition are equally well off? The two leading contenders for making this determination are the Engel and Rothbarth approaches. These approaches differ from the USDA approach in two major respects. First, they both attempt to estimate the *marginal* economic costs of the children to their parents as opposed to the *average* cost approach of the USDA. Second, and more importantly, these two approaches directly estimate the

total cost of the children and define that cost as the amount of spending made on behalf of the children. Once the total level of spending has been determined, only then can the composition of that spending to individual commodity types be determined. By contrast, the USDA approach represents a bottom-up approach. The total spending on the child is determined only *after* the child's spending on each commodity is first determined.

This report presents alternative estimates of how much is spent on children in families where both parents are present. The differences in the estimates will reflect differences in the three approaches contrasted in this report: the USDA, Engel, and Rothbarth methodologies.

The questions addressed in this report are:

- Are the estimates of child-rearing costs robust with respect to the method and assumptions used to produce them?

- How do expenditures on children increase with the number of children in the family?

- Are parents today spending the same amounts on their children as parents in the 1980s?

- How do parents increase their spending on children as total spending of the family increases?

- How do expenditures on children vary with the age of the child?

DATA AND EXPENDITURE CATEGORIES

The data used in this study are drawn from the Consumer Expenditure Survey (CEX) administered by the Bureau of Labor Statistics (BLS). The survey is based upon quarterly interviews of roughly 5,500 consumer units (families). The data are used for the periodic revisions of the Consumer Price Index as well as for other economic research and analysis of the spending patterns of American families. The CEX is the only nationally representative sample of American families that collects detailed information on the spending habits of families. As such, it is the only available survey suited for estimating parental spending patterns.

CEX Sample Selection Criteria

The data used in this study are from the interview component of the CEX beginning in the first quarter of 1996 through the first quarter of 1998. Consumer units are interviewed for five quarters; however, only data from the second through fifth quarterly interviews are reported on the public use files. While the BLS treats each quarterly response as an independent observation, this report constructs an analysis file based upon annual data and does not treat the quarterly interviews as independent. While any unit can have up to four quarterly interviews, some households cannot be located or interviewed and hence have less than four interviews. For this study, only units with at least three completed interviews were included in the final analysis sample.

This study was intended to focus on the spending patterns on children in families where both parents were present. Consequently, the following sample restrictions were made:

- The unit must include a married couple between the ages of 18 and 60 years old; and
- The unit could not include any other adults (individuals 18 years of age or older) in the unit, even if those adults were the children of the couple.

These restrictions yielded a sample of 2,294 consumer units, where 761 observations were childless married couples and 1,533 were married couples with children. Exhibit 5-1 presents the distribution of units by the number of children (individuals less than 18 years of age) in the unit.

Exhibit 5-1
Sample Observations by Number of Children

Number of Children	0	1	2	3	4	5 or More
Number of Observations	761	496	637	286	87	27

Source: calculations by author

Definition of Total Expenditures

The concept of total expenditures used in this study is the total value of the family's current consumption. While the BLS has adopted a specific definition of total expenditures, this study does not conform to that concept in three instances.

- First, the BLS has defined total expenditures to include the value of cash contributions made to members outside the unit. Since this expenditure represents consumption of non–family members, it is excluded.

- Second, the BLS definition includes the contributions that family members have made to social security and private pension plans. These expenditures correspond to the family's savings and hence are excluded.

- Finally, the BLS includes the unit's net outlay for vehicles purchased during the interview period, as well as current finance charges for the vehicles. Apart from the potential double counting, the inclusion of the net purchase price is an inappropriate way to measure the consumption value of the vehicle. This report excludes the net purchase price of the vehicles in constructing a definition of total family expenditures. (An even more appropriate approach would have been to construct a measure of the flow of consumption derived from the family's vehicles. This was not possible, however, for this study.)

Distribution of Total Expenditures

One of the major questions this study sought to examine is the extent to which the level of total spending by the family affects the proportion of spending devoted to the children. Hence, it is important to examine the distribution of total family spending by the composition of the family. Exhibit 5-2 displays this information.

Exhibit 5-2
Distribution of Total Spending by Family Composition

	Childless Couple	One Child	Two Children	Three or More Children
Average Total Expenditures	$33,500	$34,115	$34,442	$34,697
Total Expenditures at:				
5th percentile	$13,988	$13,188	$14,330	$13,661
10th percentile	15,930	17,135	17,045	16,424
20th percentile	19,568	20,811	20,675	20,837
40th percentile	25,893	27,529	27,570	26,929
50th percentile (median)	29,163	30,921	30,509	30,255
60th percentile	32,981	35,272	34,935	34,538
80th percentile	44,048	44,768	45,601	47,315
90th percentile	53,421	53,596	57,247	55,306
95th percentile	64,344	69,334	66,587	70,186

Source: calculations by author

These statistics suggest that total family spending is skewed but surprisingly similar across all family compositions. These results also suggest that the sample limits ability to predict how parents devote family resources to their children. For the purposes of this study, the conclusions that are drawn pertain to families with total levels of spending between roughly $15,000 and $70,000 of annual total expenditures in 1997 dollars.

Spending by Expenditure Categories

Adopting the BLS major commodity groupings, total family expenditures are the sum of the following categories:

- **Food**: food prepared and consumed at home and food purchased and consumed away from home;
- **Housing**: mortgage interest paid, property taxes, maintenance and repair, rent paid, home insurance, utilities, personal services including child care, housekeeping supplies, and household furnishings and equipment;
- **Apparel**: clothing, footwear, cleaning services, and supplies;
- **Transportation**: vehicle finance charges, leases, gas and oil, maintenance and repair, insurance, licenses and other charges, and public transportation;
- **Entertainment**: fees and admission, entertainment equipment, toys, and pets;
- **Health Care**: health insurance; nonreimbursed expenses for medical services, drugs, and supplies;
- **Tobacco and Alcohol;**
- **Personal Care**: personal care products and services;
- **Reading;**
- **Education**: tuition, fees, and supplies for education from grade school to college;
- **Personal Insurance**: life and other personal insurance premiums; and
- **Miscellaneous**: funeral expenses and plots, checking charges, legal and accounting fees, and interest paid on lines of credit, home equity loans, and credit cards.

Exhibit 5-3 reports the sample mean of total family expenditures by the number of children in the family as well as the budget share devoted to each of the 12 consumption categories.

Exhibit 5-3
Average Spending by Family Composition

	Childless Couple	One Child	Two Children	Three or More Children
Total Expenditures	$33,500	$34,115	$34,442	$34,697
Budget Share (% of Total Expenditures)				
Food	18.4	18.7	20.5	21.8
Housing	39.1	41.2	41.2	40.8
Apparel	4.9	5.5	5.5	5.5
Transportation	15.7	14.8	13.9	13.4
Entertainment	6.9	6.2	6.6	6.2
Health care	5.8	5.6	5.3	5.3
Tobacco and alcohol	2.4	1.9	1.8	1.7
Personal care	1.2	1.0	1.0	1.0
Reading	.7	.6	.5	.4
Education	1.5	1.5	1.2	1.2
Personal insurance	1.8	1.4	1.6	1.3
Miscellaneous	1.6	1.4	1.0	1.4

Source: calculations by author

Total family spending in the sample increases with the number of children. However, this pattern reflects not only differences in disposable (after-tax) income but differences in the proportion of disposable income spent by families with children. Examining only consumer units with complete income reports, the average disposable income of childless couples was $5,000 higher than the average disposable income of families with two children, yet their total spending was roughly $1,000 less. Clearly, children decrease the amount of savings by families. However, this effect of children will not be part of the estimates of the cost of children reported in this report.

The presence and number of children clearly increases the proportion of the family's budget devoted to food and apparel purchases. Children reduce the share of the family's budget devoted to transportation, health care, tobacco and alcohol, personal care, and reading purchases. For all other categories, the number of children has no clear effect on the family's spending patterns.

The effect of children on housing purchases is probably most surprising. While the presence of children does appear to increase housing expenditures for the first and second children in the family, the third child appears to reduce the relative size of the housing budget. In part, this is an artifact of the way the BLS defines housing purchases to include household operations that will include the cost of babysitting and child-care services. If these expenditures are omitted from this category, then

families with one, two, and three children will devote 39.1 percent, 38.8 percent, and 39.2 percent to housing. Compared to the 39.1 percent of a childless couple's budget devoted to these items, neither the presence nor number of children significantly affect the proportion of the total budget devoted to what is normally considered housing expenditures.

METHODOLOGIES FOR ALLOCATING FAMILY EXPENDITURES TO CHILDREN

Three methodologies were used in this study to allocate total family spending to the children: the USDA, Engel, and Rothbarth methodologies. Some of the information about these methodologies is by necessity technical. However, the narrative discussion is intended to be nontechnical, so the equations may be skipped without loss of the general understanding of each approach. A more formal, technical critique of the Engel and Rothbarth methodologies is presented in Appendix C.

Direct Estimates of Spending on Children—The USDA Methodology

When the question of how much parents spend on their children is first confronted, an initial reaction might be that this should be a relatively simple, straightforward exercise. What is needed appears simple: first, an inquiry as to who consumed each item the family purchased; then, addition of the purchases by each family member. For goods whose consumption can in principle be restricted to a single individual or to similar individuals, such as children or adults, this procedure could be used to allocate the family's purchases. But how can goods that are shared among family members, such as housing, be allocated?

The USDA approach to this problem is to determine whether the adults or the children would be the primary beneficiaries of the goods. Goods that are exclusively adult goods are excluded from any allocation to the children. The USDA has designated adult clothing, tobacco and alcohol, personal insurance, and miscellaneous expenditures as adult goods.[33] On average, these goods account for 6–7 percent of a family's budget.

The next step is to identify goods that are exclusively consumed by the children in the family. These goods include children's clothing, babysitting and child care, and

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[33] The designation of personal insurance–life and disability insurance–as an adult good is questionable, since often a principal reason to purchase this type of insurance is to protect the income flows of the parents for the benefit of the children. However, this study will follow the USDA's designation of personal insurance as an adult good.

education expenses.[34] On average, families devote about 5 percent of their family's budgets to these items. Thus, the combined total of goods that can be designated either as adult or children's goods is roughly 12 percent of the family's budget. For the remaining 88 percent of the budget, the portion allocated to the children must rely either on information from other studies or on the use of a per capita allocation.

The second largest budget category for families with children is food. The USDA allocates the food bill based upon the nutritional needs of the individual family members as defined by the USDA 1994 food plans. Because the exact food plans used by the USDA weren't available, the relative food budgets in the 1998 Moderate-Cost Food Plan were used for the purposes of this report. First, the acceptable food budget for a child of a given age, relative to the food budget for an adult, was calculated. Then, the food scales shown in Exhibit 5-4 were used for each of the five age categories of children.

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Exhibit 5-4
Relative Food Needs of Children*

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Age of Child	0–2	3–5	6–12	13–15	16–17
Food Scales	.511	.570	.802	.943	.969

   * While the food plan distinguishes between the food needs of males and females, no
   distinction was made in this study.

These food scales were then used by first taking the sum of the product of each food scale times the number of children of that age. This sum represents the number of children in the family expressed in terms of the number of food equivalent adults. For example, if a 4-person family had an 8-year-old child and a 16-year-old child, the two children would be equivalent to 1.771 adults in terms of their nutritional needs. If food was allocated in relation to nutritional needs, then the children would have received 47 percent of the food $(1.771/(2 + 1.771) = 0.47)$, which is only slightly less than a per capita allocation (50 percent). This method of food allocation will depart even further from a per capita allocation depending upon the ages of the children in the family. For example, if the second child was 5 years old instead of 16 years old, then 41 percent $(1.372/(2+1.372) = 0.41)$ of the food budget would be allocated to children.

The USDA uses information from the 1987 National Medical Care Expenditure Survey to allocate the family's out-of-pocket medical expenses. Using this survey,

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[34] The choice of education is problematic since childless couples are also observed to incur educational expenses. To the extent that these expenses are truly made for the adults in the family, then part of the observed educational expenses in families with children could also be devoted to the parents and not the children.

health-care scales were developed that are similar to the above food scales, but that relate the average spending on children to that of adults. For children less than 6 years old, the health care-scale was .696. For children 6 years old and older, the scale was .786. These scales were used in exactly the same manner as food scales. For example, for the family with children who are 8 and 16 years old, 44 percent $(1.572/(2+1.572) = 0.44)$ of the health-care expenses would be allocated to the two children.

Transportation is the final commodity singled out for special treatment. The USDA argues that work-related expenses should not be allocated to the children, but all other transportation expenses should be allocated on a per capita basis. Based on a 1990 U.S. Department of Transportation study, 40 percent of transportation expenses were for work-related travel if the youngest child in the family was less than 6 years old. When the youngest child was 6 years old or older, the share fell to 38 percent. To illustrate this allocation procedure, it will be assumed that the family spends 15 percent of its budget on transportation and has two children both over 6 years old. Then the family would be assumed to spend 4.65 percent of the total family budget on transportation for the two children.

$$(1-.38) \times \frac{2}{4} \times 15\% = 4.65\%$$

This method departs significantly from a pure per capita allocation, especially compared to the food and health-care allocations. Per capita allocation would have attributed 50 percent of the transportation budget to the children. By excluding roughly 38 percent of the transportation budget to be allocated to the children, the USDA methodology reduces the children's allocation to 31 percent of the transportation budget.

After these allocations have been made, still roughly one-half of the family's budget remains to be allocated. The USDA approach then employs a per capita allocation (number of children/family size) to allocate the remaining expenditure categories to the children.

As the USDA methodology has been described, the spending of each family can be allocated to the children when there is information available about the family's spending patterns and the ages and number of children in the family are known. In the results presented in the next chapter, that is exactly what was done. However, before examining the results based on allocations done at the family level, the USDA approach should be applied to the average spending patterns of families.

To formalize the USDA methodology, the following notation will be adopted.

E =   the budget share of adult or excluded goods—adult clothing, tobacco and alcohol, personal insurance, and miscellaneous expenditures;[35]

C =   the budget share of children's goods—child clothing, child care, and education;

F =   the budget share of food;

H =   the budget share for out-of-pocket health-care expenditures;

T =   the budget share for transportation;

r =   per capita allocation = number of children/family size;

f =   the relative food needs of children relative to the family's food needs;

h =   the average spending of the children relative to the average family spending on health care; and

w =   the proportion of transportation expenses that are work related.

Using this notation, the USDA methodology would indicate that the proportion of the family's total spending devoted to the children would be equal to

$$C + fF + hH + (1 - w)rT + r(100 - E - C - F - H - T) \qquad (1)$$

Assuming that the average age of a child is between 6 and 12 years, the values for the four allocation factors are shown in Exhibit 5-5.

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[35] The USDA in its reports defines the miscellaneous category as including personal care, entertainment, and reading expenditures. Note that this report uses the BLS's definition of commodities that composed the miscellaneous category.

Exhibit 5-5
Parameter Assumptions

Number of Children:	1	2	3
r	.333	.500	.667
f	.286	.445	.546
h	.282	.440	.541
$(1-w)\,r$	.207	.310	.414

Exhibit 5-6 reports average values for *C, F, H, T,* and *E* for families with one, two, and three children. Using these average values and equation 1, the average proportion of total family spending devoted to the children would be equal to 31.2 percent, 45.6 percent, and 57.7 percent for one, two, and three children respectively. These estimates suggest that the USDA approach can be expected to yield allocations to children that are slightly less than a per capita allocation (33, 50, and 60 percent).

Exhibit 5-6
Allocation of Spending by Family Composition
(Percentage of Total Expenditures)

	One Child	Two Children	Three or More Children
Exclusions			
Adult clothing	2.4	2.0	1.6
Tobacco and alcohol	1.9	1.8	1.7
Personal insurance	1.4	1.6	1.3
Miscellaneous	1.4	1.0	1.4
Total Exclusions	**7.1**	**6.4**	**6.0**
Child Goods			
Child clothing	1.4	2.0	2.4
Babysitting and child care	2.1	2.4	1.6
Education	1.5	1.2	1.2
Total Child Goods	**5.0**	**5.6**	**5.2**
Allocations Based Upon Other Studies			
Food	18.7	20.5	21.8
Transportation	14.8	13.9	13.4
Health care	5.6	5.3	5.3
Per capita Allocation:			
Housing – child care	39.1	38.8	39.2
Apparel – clothing	1.7	1.5	1.5
Entertainment	6.2	6.6	6.2
Personal care	1.0	1.0	1.0
Reading	.6	.5	.4
Total Per Capita Allocation	**48.6**	**48.4**	**48.3**

Source: calculations by author

Let *S* denote the level of total family spending, then the change in the share of the family's budget devoted to the children with respect to changes in S is equal to

$$(1-r)\frac{\P C}{\P S} + (f-r)\frac{\P F}{\P S} + (h-r)\frac{\P H}{\P S} - wr\frac{\P T}{\P S} - r\frac{\P E}{\P S}. \tag{2}$$

The direction of the total impact of a change in the level of the family's total spending on the proportion that is devoted to the children cannot be determined theoretically.

If food, health care, and transportation expenses are necessities, and goods exclusively devoted to children are luxuries, then the proportion of total family spending devoted to the children can be expected to increase with total spending. However, if goods that are explicitly excluded from being allocated to children increase with total spending, then the total impact of increases in total spending cannot be determined.

To evaluate whether or not parents can be expected to devote larger or smaller shares of the family's total spending to their children, the budget share of various consumption categories will be compared with total spending. Using the analysis sample, the budget share of C, F, H, T, and E were regressed on the family's total spending for one-, two-, and three-children families separately. The regression results are presented in Exhibit 5-7. The asterisk indicates that the effect of total spending on the budget share was significant at a 5 percent level.

Exhibit 5-7
The Effect of an Increase of $1,000 of Total Family Spending on Budget Shares

Number of Children:	One	Two	Three or More
C	.007	.023*	-.010
F	-.182*	-.206*	-.197*
H	.005	-.026*	.015
T	-.018	-.033*	-.014
E	.031*	.032*	.020
Net Effect on Child Spending	.005	.015	.009

For all numbers of children, the budget share of those goods excluded from allocation, *E,* rose with total spending. However only in the case of families with one and two children is this effect significant. Employing these estimates and the assumptions about the parameters, *r, f, h,* and *w*, equation 2 predicts that spending on children should be expected to increase with total spending. The primary factor that creates this result is the relatively large estimated income share elasticity of food.

What has been described as the USDA methodology is not precisely how the USDA proceeds, but it is in the spirit of its approach. Specifically, the USDA has adopted seven categories: (1) food, (2) housing minus child care expenses, (3) transportation (including the net outlays for new and used vehicles), (4) children's clothing, (5) health care, (6) combined child care and education expenses, and (7) an "other" category that combines personal care, entertainment, and reading material. The USDA allocates the consumption in each of the seven categories to each child using the above-described allocation methods. It then conducts a multivariate analysis of the expenditures for the youngest child in each of the seven categories, controlling

for the number of children, age of the younger child in the two-child family, and the family's before-tax income (not total spending). Then, using the sample of families with two children, a similar analysis is completed for the older child, controlling for his or her age as well as income. This analysis shows that after controlling for any differences in children's ages, the family's expenditures on the older child are roughly equal to the amount of spending on the younger child.[36]

Finally, the USDA estimates an adjustment for the number of children to reflect economies of scale in family consumption by conducting a third multivariate analysis of the seven consumption categories. The results of this analysis suggest that families with one child spend 24 percent more on the single child than a family with two children does on each of their children separately. Families with three or more children spend 23 percent less per child than does a family with two children.

To estimate the expenditures on a child, the USDA computes for each child in the family the expected expenditures on each of the seven commodity categories given the child's age and the family's income. The economies-of-scale adjustment is then applied to the sum of the expected consumption for all children in the family to arrive at the final estimate of parental spending on children.

The difference between the actual procedures used by the USDA and this study is where and when the averaging of the estimates of spending on children is performed. In this study, the averaging is done at the final stage when estimates of the proportion of total spending devoted to the children are averaged across similar families. In the USDA approach, the averaging is done at the first step when the multivariate analysis of the seven separate commodity categories is performed. It is at this stage where the differences between families are eliminated in the USDA procedure. Only if zero values for the individual consumption categories significantly affect the averaging procedure in the USDA approach should these two different procedures be expected to produce different results.

Indirect Estimates—Engel and Rothbarth Methodologies

While the approach taken by the USDA is straightforward and relatively easy to understand, its main weakness is the rather arbitrary manner in which it allocates roughly one-half of the family's spending. The use of a per capita allocation brings the whole methodology into question. The use of this untestable assumption may be considered wholly unreasonable and can lead to overstating how much parents truly

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[36] Given the method by which the expenditures are allocated to the individual children, this result should not be too surprising. In the public use file, none of the goods can be assigned directly to any specific child in the family but just to all children. However, some differences could arise when one uses the internal BLS files because child clothing can be assigned to the specific child for whom it was purchased.

spend on their children. But without any other additional information about how individual members consume or utilize the specific consumption items, what alternative assumptions can be made?

One alternative approach to the allocation problem would be to focus on how parents reallocate consumption within the household in order to make room for their children's consumption. By comparing the consumption decisions of parents with children and married couples without children, the economic costs of the children can be indirectly observed from the differences in consumption patterns. When undertaking this comparison between families with and without children, everything else would be held constant in the comparison to make sure that any remaining differences could reasonably be attributed to the presence of the children. While the characteristics of the adults and the market prices that they face should be held constant, the standard of living—or the family's well-being—should also be held constant across the two families.

The difficulty with this approach is that it trades one problem for another. Now, the economic well-being of the family needs to be held constant, but this cannot be done directly. Faced with this dilemma, the next best step is to find an observable proxy for the family's standard of living that can be measured and hence held constant.

The search for an economic proxy for the family's standard of living has been difficult and not wholly successful. The use of income or even total expenditures in the family would be unacceptable measures of a family's well-being. Also, families that both have the same total expenditures or income, but one has children and the other does not have children, could not possibly be equally well off, since, at a minimum, the family with children would have more mouths to feed and more bodies to clothe and shelter than the family without children.

A concept that could in principle be measured for all families is needed when searching for a proxy for the family's standard of living. This would restrict a search to goods that were necessities—goods that are "needed" and hence purchased by all families. Of goods that are necessities, food is an example, and it was this consumption item that Engel focused on over 100 years ago as an appropriate proxy for a family's standard of living.[37]

Just because food is purchased by all families, however, does not make it a sufficient proxy for family well-being. At a minimum, the proxy should move in the same direction with known changes in the family's standard of living. Engel observed that food consumption did indeed meet this additional necessary condition. It can reasonably be assumed that if the number of family members is held constant, an increase in the family's total expenditures should make the family better off. What

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[37] Ernst Engel, "Die Lebenskosten Belgischer Arbeiter-Familien Früher and Jetzt" (1895) 9(1) *International Statistical Bulletin* 1–124.

Engel observed was that when total spending increased, the family spent more on food, but the share of food in the family's budget fell. This is what should be expected if food is a necessity, and it is also what was found in Exhibit 5-3. This indicates that food shares are potentially an inverse proxy for the family's standard of living; that is, they move in opposite directions.

Comparing families with different numbers of members but that have the same level of total spending should also create differences in well-being across the families. Here, it would be expected that as the number of family members increases, the family would be worse off. Thus, if food shares are truly an inverse proxy for the family's standard of living, it would be expected that food's share of the family budget should rise with the number of children if the level of total spending is held constant. While the total level of spending was not exactly held constant, Table 5-3 shows that the number of children does increase the share of the family budget devoted to food.

These observations led Engel and many other researchers such as Espenshade[38] to adopt food shares as a (inverse) proxy for the family's standard of living. When food shares are used as the proxy, this approach is denoted as the Engel methodology. But food is just one component of the bundle of goods that are believed to be necessities. Housing, clothing, and medical care would fit the economic definition of a necessity where the share of the budget devoted to this group of goods falls with increased total spending of the family. Watts proposed well-being proxies based upon this wider set of consumption items, including food.[39] This approach, denoted as the Iso-Prop method, is not empirically examined in this report.

To illustrate how Engel estimates are arrived at, it is assumed that the budget share is a linear function of (1) a set of characteristics of the adults in the family (*g(X)*), (2) the proportion of the family that is in different age groups (*a(K)*), (3) the log of the family size, and (4) the log of per capita total spending. This functional form is based on the work of Working[40] and more recently by Deaton and Paxson,[41] all of whom found it to fit the data quite well. Assuming that the sample has been restricted to two adults and where K is the number of children in the family, the proposed equation for the food budget share (*F*) would be equal to[42]

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[38] Thomas Espenshade, *Investing in Children: New Estimates of Parental Expenditures* (Washington, D.C.: The Urban Institute Press, 1984).

[39] Harold Watts, "The Iso-Prop Index: An Approach to the Determination of Differential Poverty Income Thresholds," in *Improving Economic Measures of Well-Being,* ed. by Moon and Smolensky (New York: Academic Press, 1977).

[40] Hollbrook Working, "Statistical Laws of Family Expenditure (1943) 38 *Journal of the American Statistical Association* 43–56.

[41] Angus Deaton and Christina Paxson, "Economies of Scale, Household Size, and the Demand for Food" (1998) 106(5) *Journal of Political Economy* 897–930.

[42] This report will show that the choice of linearity of the food share equation with regard to the family's total spending implies that the share of spending devoted to the children is independent of

$$ln(F[K, S, X]) = g(X) + a(K) + d\,ln(2 + K) + b\,ln\left(\frac{S}{2 + K}\right) \tag{3}$$

If food is a necessity, then b should be negative. If the food share is to increase with the number of children (family size)—assuming total spending (S) is held constant—then

$$(a(K) - a(0)) + (d - b)ln\left(\frac{2+K}{2}\right) > 0$$

This functional form was chosen because it separates the various effects that differences in families can have on the proportion of spending devoted to food consumption. Holding per capita total spending constant, including the log of family size, accounts for an additional effect of the size of the family on food consumption and is intended to capture the effect of economies of scale. Children also will enter the model by altering the age composition of the family. This effect is captured in the model notation by the term, $a(K)$. Specifically, the age composition of the family will be captured by a series of variables representing the proportion of the family whose ages fall into a given interval. These variables should reflect differences in the age composition and not the size of the family. The final term, $g(X)$, captures the effect of other differences in families that are not directly related to the size of the family or its age composition. Examples of these factors could include the education and race of the parents.

Engel assumes that if the food share equation meets these restrictions, then it will be a good proxy for the family's standard of living. The next step in the Engel methodology is to ask at what level of total spending, S_0, would a married couple with no children be equally as well off as a married couple with K children and S_K amount of total expenditures. The following equation is necessary when computing this level of spending: equate the food shares equation and solve for S_0

$$F[0, S_0, X] = F[K, S_K, X]$$

$$g(X) + a(0) + d\,ln(2) + b\,ln\left(\frac{S_0}{2}\right) = g(X) + a(K) + d\,ln(2 + K) + b\,ln\left(\frac{S_K}{2 + K}\right)$$

$$S_0 = S_K \times \frac{2}{2 + K} \times exp\left[\frac{(a(K) - a(0)) + d\,ln\left(\frac{2+K}{2}\right)}{b}\right] = S_K \times \frac{2}{2 + K} \times exp[Y].$$

Attributing the difference $S_K - S_0$ as the expenditures made on behalf of the K children, then the proportion of total spending devoted to the children would be equal to

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the level of total family spending. This is, of course, not a desirable feature and to construct an estimation model that would allow for the share of spending devoted to the children to be dependent upon total family spending, the square of the log of total family spending was added to equation 3.

$$\frac{S_K - S_0}{S_K} = 1 - \frac{2}{2+K} \ exp[Y].$$ (4)

Compared to the allocation of consumption within the family based on the children's relative representation in the family (K/(2+K)), equation 4 implies that if

$Y > 0$ then children receive less than their relative representation in the family; or

$Y = 0$ then per capita allocation is appropriate; or

$Y < 0$ then children receive more than their relative representation in the family.

While this suggests that the data will determine the appropriate allocation of consumption to the children and not the model, the maintained hypothesis is that the children's share of total spending is less than their relative representation in the family, and hence it would be expected that

$$\left(a(K) - a(0)\right) + d \, ln\left(\tfrac{2+K}{2}\right) < 0.$$

In other words, adding children to the family should reduce the share of the budget devoted to food when per capita family total spending is held constant. In the absence of any significant effects of the age composition on the family's food consumption, d would then be expected to be negative.

Gorman demonstrated that the Engel approach was consistent with traditional consumer theory under the assumption that the economies of scale in food consumption were the same as for all other goods.[43] While this assumption can be used to justify this approach, it can conversely be used to cast doubt upon the entire endeavor. Deaton and Paxson observed that the scale economies in food consumption were quite different from other goods. For example, the relative degree to which families share housing implies that the scale economies of housing are most likely larger than the scale economies for food. Deaton and Paxson reasoned that the differential scale effect would have the same impact on the family's consumption decisions as a change in the relative price of food. The only assumption that would rationalize the Engel approach would be that the family does not respond to this change in relative prices. However, if this were true, then the impact of adding a child to the family—holding per capita total spending constant—would be to increase the budget share of food. This would imply that the share of the family spending devoted to the children is more than their relative representation in the family. On the other hand, a negative effect of children would imply that the family did in fact respond to the differential scale economies. But then the Engel approach

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[43] William Gorman, "Tricks with Utility Functions," in *Essays in Economic Analysis,* ed. by Artis and Nobay (Cambridge, England: Cambridge University Press, 1976).

cannot identify the amount of compensation required to equate the standard of living of families with children to those without children.[44]

Deaton and Paxson present the following dilemma. The Engel method will produce biased estimates of how much parents spend on their children, but it will not be known whether the bias serves to allocate more or less to the children. Given this potential state of affairs, it makes sense to question whether relying on the Engel method to inform policy is wise.

A second indirect alternative to the allocation problem is the Rothbarth method. This approach is based on the following observation: without any additional resources to the family, parents must make room for the consumption of their children by reducing purchases they make for themselves. Adult clothing can be considered as a proxy for all adult spending. If Rothbarth is correct, then spending on adult clothing would be expected to fall as the number of children increases. On average, couples without children spend $1,150 on adult clothing, while parents with one, two, and three or more children spend $909, $757, and $638 respectively. Rothbarth suggested that by examining how adult goods varied by family type and total spending one could infer how much total spending would be required to make families with and without children equally well off.[45]

The same functional form as food consumption will be used to describe the spending patterns of families on adult clothing. In particular, it will be assumed that

$$ln\big(A[K, S, X]\big) = \mathbf{m}(X) + \mathbf{f}(K) + \mathbf{t}\, ln(2 + K) + \mathbf{l}\, ln\!\left(\frac{S}{2 + K}\right) \tag{5}$$

where A denotes the dollar purchases of adult clothing and all other variables (X,K,S) are defined the same as they are above. For adult goods to be a proxy for the family's well-being, increases in total spending should increase spending on adult goods ($\mathbf{l} > 0$). Also, as more children are added to the family while holding total spending constant, adult spending (well-being) should decline. This latter condition requires that

$$\big(\mathbf{f}(K) - \mathbf{f}(0)\big) + \big(\mathbf{t} - \mathbf{l}\big) ln(2 + k) < 0 .$$

Ignoring the impact that the relative age composition has on adult clothing purchases, this restriction will be met if $\mathbf{t}$ is less than $\mathbf{l}$. This condition does not require $\mathbf{t}$ to be negative as was required for the effect of the log of family size on food consumption holding per capita spending constant.

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[44] For a more detailed explanation, see Appendix C.
[45] A more formal justification for the Rothbarth approach is given in Appendix C.

The first step in the Rothbarth method is to calculate the level of total spending a childless couple would require so that they would spend the same amount on clothing as the parents with K children and S_K amount of total spending. For the above functional form, this level of total spending would be equal to

$$S_o = S_K \times \frac{2}{2+K} \times exp\left[\frac{(f(K)-f(0))+t\, ln\left(\frac{2+K}{2}\right)}{l}\right] = S_K \times \frac{2}{2+K} \times exp[F].$$

Attributing the difference in total spending as the amount of spending the parents make on their children, then the share of total spending that was devoted to the children would be equal to

$$\frac{S_K - S_0}{S_K} = 1 - \frac{2}{2+K} \quad exp[F]. \tag{6}$$

If F is positive, then the imputed share of spending devoted to the children will be less than their relative representation in the family.

Appendix C demonstrates that for the Rothbarth approach to be consistent with consumer theory, two conditions must be met. The first condition is that when per capita total spending is held constant, additional children will increase spending on adult clothing.

$$(f(K)-f(0))+t\, ln\left(\frac{2+K}{2}\right) > 0$$

Ignoring the effect of the change in the age composition of the family, this condition will be met as long as t is positive. This restriction can be met by the Rothbarth method since the only restriction placed by this approach is that $(t-l)$ is negative. If this restriction is met, then F will be positive and children will be allocated a share of family spending less than a per capita share.

The second condition is that the purchases of adult clothing must be unresponsive to changes in relative prices. This condition is unlikely to be met. However, it can be determined that the bias in the procedure will result in an understatement of the share of total spending devoted to the children.

To empirically implement both the Engel and Rothbarth approaches, the following variables were used in the estimation of equations 3 and 5:

g(X) and *m(X)* variables:

    black   = 1 if race of head is black;
    hs_no_hs = 1 if the education of the husband is less than a high school diploma;
    hs_coll   = 1 if the education of the husband is more than a high school diploma;
    sp_no_hs = 1 if the education of the wife is less than a high school diploma;

sp_coll   = 1 if the education of the husband is more than a high school diploma;
twoern   = 1 if both the husband and wife work;
w_work   = weeks worked by the wife;
ftime   = 1 if the usual work week of the wife was greater than 35 hours.

$a(K)$ and $f(K)$ variables:

k02   = proportion of the family whose age is less than 3 years old;
k35   = proportion of the family aged 3 to 5 years old;
k612   = proportion of the family aged 6 to 12 years old;
k1315   = proportion of the family aged 13 to 15 years old;
k1617   = proportion of the family aged 16 and 17 years old;
a1820   = proportion of the family aged 18 to 20 years old;
a2130   = proportion of the family aged 21 to 30 years old;
a4150*   = proportion of the family aged 41 to 50 years old;
a5160   = proportion of the family aged 51 to 60 years old;

(Note that the omitted category was the proportion of the family aged 31 to 40 years old.)

lnfsize   = log of family size (2+K)

lnpctx   = the log of total expenditures divided by family size (in $1,000)
lnpctx2   = the square of lnpctx

The inclusion of the square of per capita total family expenditures allows the share of total spending devoted to the children to vary with the level of total spending. In the discussion, variables have been omitted in order to derive explicit equations for the share of total spending made on children (equations 4 and 6). Including this squared term requires numerical techniques to determine the amount of compensation needed to equate the well-being of families with and without children.

Expenditures for food made at home were used as the measure of food consumption in the Engel method. The dependent variable was then expressed as the log of the budget share for food purchased for home consumption. Purchases of men's and women's clothing were used in the Rothbarth method. Since equation 5 is expressed in terms of the log of adult clothing purchases, 86 observations were excluded from the analysis sample in the estimation of the Rothbarth model. The OLS estimates of equations 3 and 5 appear in Exhibits 5-8 and 5-9 on the following pages.

Exhibit 5-8
Engel Model Results
Dependent Variable: Log of the Budget Share of Food at Home

Source	ss	df	MS		Number of obs =	2294
					F (20, 2273) =	116.97
Model	262.423643	20	13.1211821		Prob > F =	0.0000
Residual	254.981091	2273	.112178218		R-squared =	0.5072
					Adj R-squared =	0.5029
Total	517.404734	2293	.225645326		Root MSE =	.33493

lnfhmshr	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
black	-.1303913	.0289638	-4502	0.000	-.1871895	-.0735931
hd_no_hs	-.0164093	.0278909	-0.588	0.556	-.0711036	.0382849
hd_coll	-.0204064	.0176268	-1.158	0.247	-.0549727	.0141599
sp_no_hs	.0746043	.0292843	2.548	0.011	.0171775	.1320311
sp_coll	-.0162038	.017565	-0.923	0.356	-.0506489	.0182413
twoern	-.074092	.0257289	-2.880	0.004	-.1245466	-.0236374
w_work	-.0192493	.0300475	-0.641	0.522	-.0781726	.0396741
ftime	.001057	.0212988	0.050	0.960	-.0407101	.042824
k02	-.1127346	.2146943	-0.525	0.600	-.533752	.3082827
k35	.2080836	.2217175	0.939	0.348	-.2267063	.6428735
k612	.2554816	.2233016	1.144	0.253	-.1824146	.6933778
k1315	.3564215	.222189	1.604	0.109	-.079293	.7921359
k1617	.283794	.2210097	1.284	0.199	-.1496078	.7171957
a1820	.0574208	.1504435	0.382	0.703	-.2376	.3524417
a2130	-.1481026	.0358385	-4.133	0.000	-.2183822	-.0778231
a4150	.1060456	.0325171	3.261	0.001	.0422793	.1698119
a5160	.1188946	.0331527	3.586	0.000	.0538818	.1839073
lnfsize	-.2983857	.1406219	-2.122	0.034	-.5741464	-.0226251
lnpctx	-.4110296	.0698041	-5.888	0.000	-.5479159	-.2741433
lnpctx2	-.0401895	.0144223	-2.787	0.005	-.0684718	-.0119072
_cons	-.5068736	.1465667	-3.458	0.001	-7942921	-.2194552

Exhibit 5-9
Rothbarth Model Results
Dependent Variable: Log of Adult Clothing Expenditures

Source	ss	df	MS				
					Number of obs =	2208	
					F (20, 2187) =	76.00	
Model	1317.20814	20	65.8604069		Prob > F =	0.0000	
Residual	1895.13175	2187	.866544008		R-squared =	0.4100	
					Adj R-squared =	0.4047	
Total	3212.33988	2207	1.45552328		Root MSE =	.93088	

lnacloth	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
black	.2176068	.0834155	2.609	0.009	.0540249	.3811887
hd_no_hs	-.0163035	.0809508	-0.201	0.840	-.1750519	.142445
hd_coll	.1315272	.0499255	2.634	0.008	.0336208	.2294336
sp_no_hs	-.0509391	.0851648	-0.598	0.550	-.2179514	.1160732
sp_coll	.0132366	.0497763	0.266	0.790	-.0843773	.1108504
twoern	.1454715	.0730987	1.990	0.047	.0021214	.2888217
w_work	-.1301874	.0853245	-1.526	0.127	-.2975128	.0371381
ftime	.0381694	.0602771	0.633	0.527	-.0800369	.1563757
k02	-1.332306	.6134629	-2.172	0.030	-2.535337	-.1292756
k35	-1.562365	.6326407	-2.470	0.014	-2.803004	-.3217251
k612	-1.522851	.6393154	-2.382	0.017	-2.77658	-.2691219
k1315	-1.280312	.6343217	-2.018	0.044	-2.524248	-.036376
k1617	.7547665	.630721	1.197	0.232	-.4821084	1.991641
a1820	-.8621443	.4231457	-2.037	0.042	-1.691954	-.0323348
a2130	.2654914	.1012077	2.623	0.009	.0670181	.4639646
a4150	-.1350928	.0916283	-1.474	.0141	-.3147803	.0445948
a5160	-.0406891	.0933374	-0.436	0.663	-.2237284	.1423502
lnfsize	1.603558	.4034592	3.975	0.000	.8123545	2.394761
lnpctx	2.105921	.2077846	10.135	0.000	1.698445	2.513397
lnpctx2	-.1445273	.0424108	-3.408	0.001	-.227697	-.0613577
_cons	.652167	.4258366	1.531	0.126	-.1829196	1.487254

The explanatory power of both the Engel and Rothbarth models is quite high for cross-sectional data. The specification of the Engel model captures 50 percent of the variation in the family's budget devoted to food at home, while the specification of the Rothbarth model captures 40 percent of the variation in purchases of adult clothing.

Variables such as the race, education, and work experience of the parents can affect budget decisions of the family. For example, blacks spend less on food but more on adult clothing compared to nonblacks, and families where both parents are working spend less of their budget on food but more on adult clothing than families with only one parent working. But these variables are assumed to be invariant to the presence of children. Given this assumption, these variables will not affect the estimates of the cost of children and consequently the percentage of the family's budget devoted to the children.

The Engel estimates confirm that food at home is a necessity. As total spending rises, the budget share devoted to food at home declines at a declining rate. While this satisfies the first of the Engel restrictions, the Engel method also requires that while holding total spending constant the food share should increase when family size (number of children) rises. To verify that this second condition is met by the estimates, the expected shares devoted to food at home by childless couples (Kid0) and families with one, two, and three children have been plotted.[46] Figure 5-1 displays these plots as a function of total expenditures and shows that the food share rises as more children are added to the family.

The Rothbarth approach requires that adults spend more on their clothing as total spending increases. The estimated model indicates that adults will increase spending on adult clothing; however, the rate of increased spending on clothing does decline with increased total spending. The Rothbarth method also requires that as the family size increases, the adults will reduce their spending on adult clothing. Figure 5-2 displays the expected amount of spending on adult clothing for childless couples and families with children.[47] As required by the Rothbarth approach, spending does fall as the number of children increases.

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[46] The plots are for a couple where both parents are between 31 and 40 years of age and both have a high school education. The plots also assume that only the husband works. The children are assumed to be between the ages of 6 and 12 years old.

[47] The same assumptions about the characteristics of the family were made for this graph as were made for the Engel food shares in Figure 5-1.

Figure 5-1
Predicted Food Budget Share as a Function of Total Expenditures
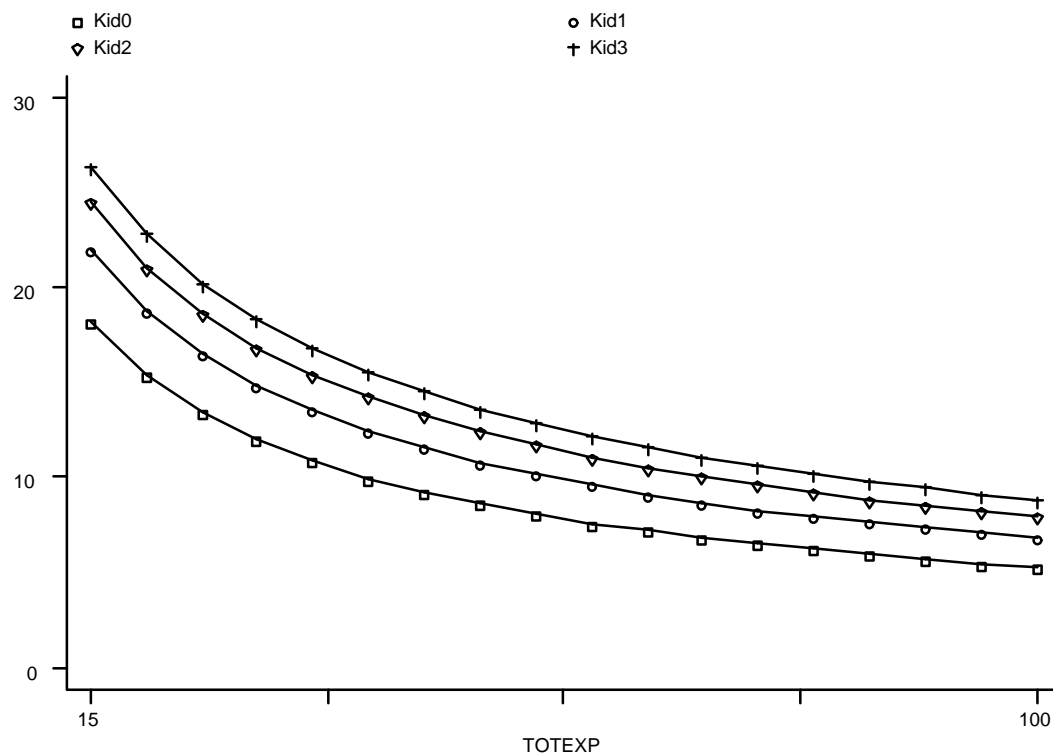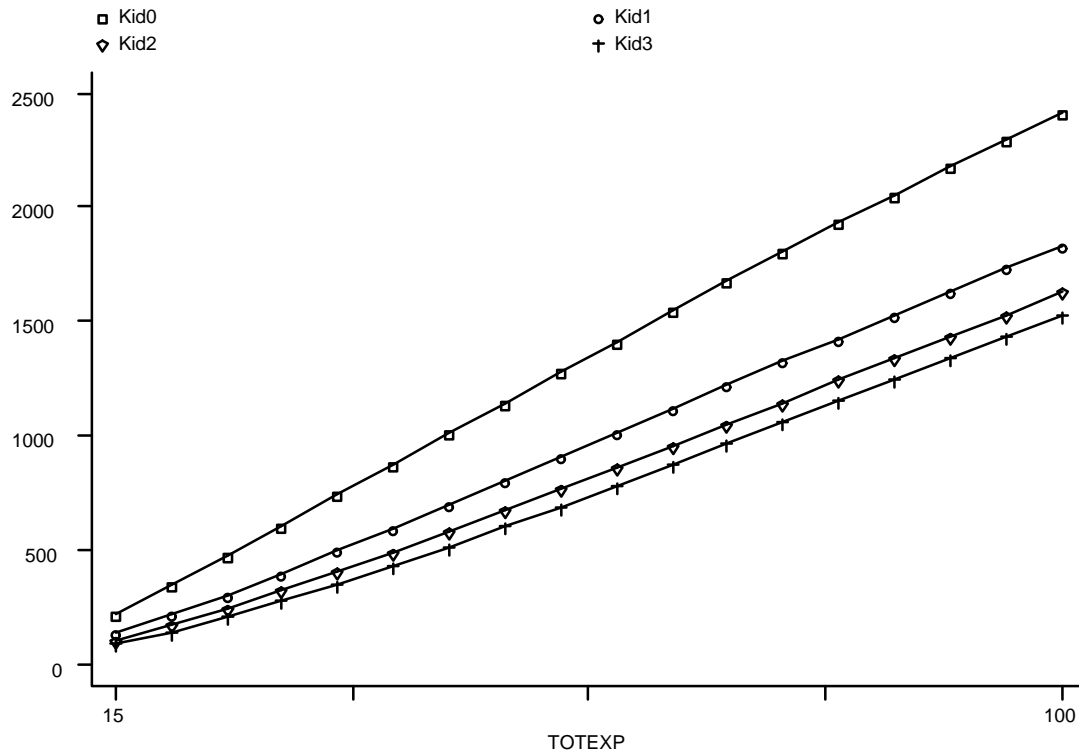**for Childless Couples and Families with Children**
(in $1,000)

Figure 5-2
Predicted Expenditures on Adult Clothing as a Function of Total Expenditures
for Childless Couples and Families with Children
(in $1,000)

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ESTIMATES OF PARENTAL SPENDING ON CHILDREN

The estimates of the proportion of family spending that is devoted to children as derived from the three alternative methodologies described above—the USDA, Engel, and Rothbarth approaches—are presented here. First, the estimates for one, two, and three children averaged over all levels of spending and ages of children are presented. Then, these estimates are compared with the Engel and Rothbarth estimates from Dr. David Betson's earlier study using data from the 1980 to 1986 CEX.[48] Finally, the variation of the current estimates with the level of total spending and ages of the children is presented.

Average USDA Estimates

Implementation of the USDA method used directly computes the proportion of total spending that is devoted to the children for each family. Figures 5-3 and 5-4 plot the share of family spending devoted to the children as a function of total family expenditures (log of total spending). In both figures, the percentage of total expenditures that would have been devoted to the children if the allocation were done on a strictly per capita basis is also drawn. While there is considerable variation in the share of family spending devoted to the children, the majority of the observations are estimated to provide less than a per capita allocation to the children.

Averaging across all levels of total spending and ages of the children, 30.4 percent, 44.9 percent, and 53.5 percent are the average shares of family expenditures devoted to one, two, and three children respectively. The standard deviation of the children's share of family spending is 3.7, 3.4, and 3.3 percentage points respectively. Given the level of precision of these estimates, the hypothesis at a 10 percent significance level that the USDA estimates differ from a per capita allocation for one and two children cannot be rejected.[49] However, for three children a significant difference is not found.

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[48] David Betson, "Alternative Estimates of the Cost of Children From the 1980–1986 Consumer Expenditure Survey," Institute for Research on Poverty Special Report Series, Madison, Wisconsin (1990).

[49] The remainder of this report will consistently use a 10 percent level of significance for all hypothesis tests.

Figure 5-3
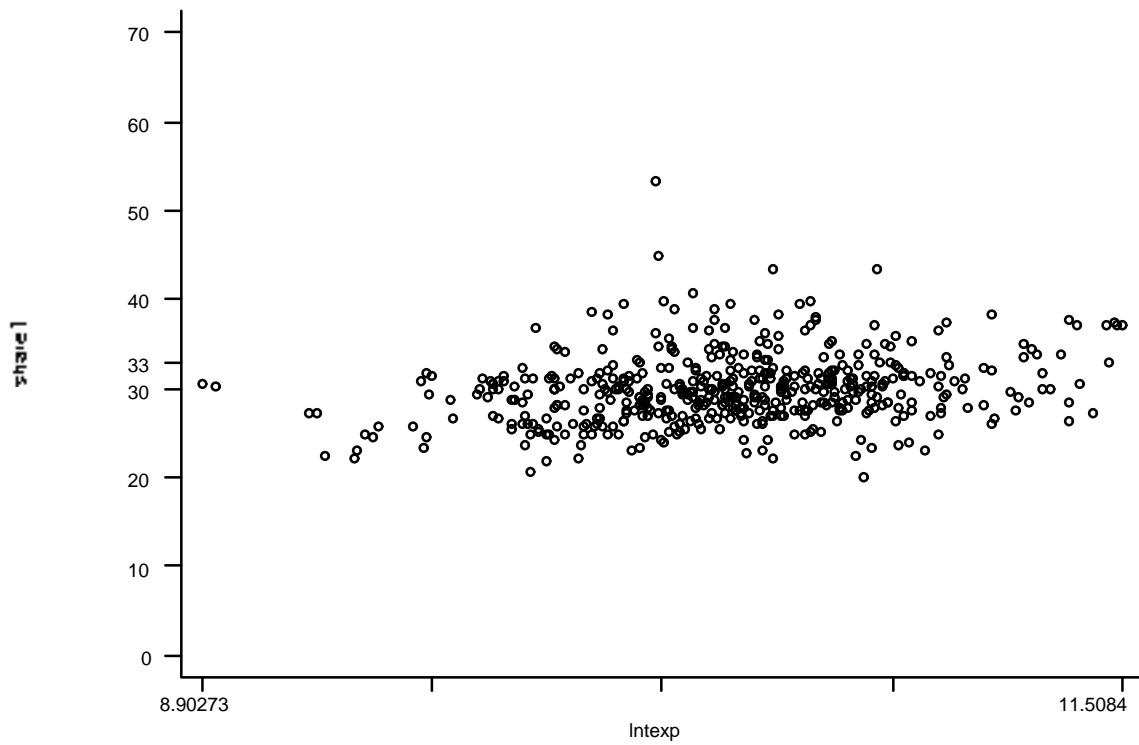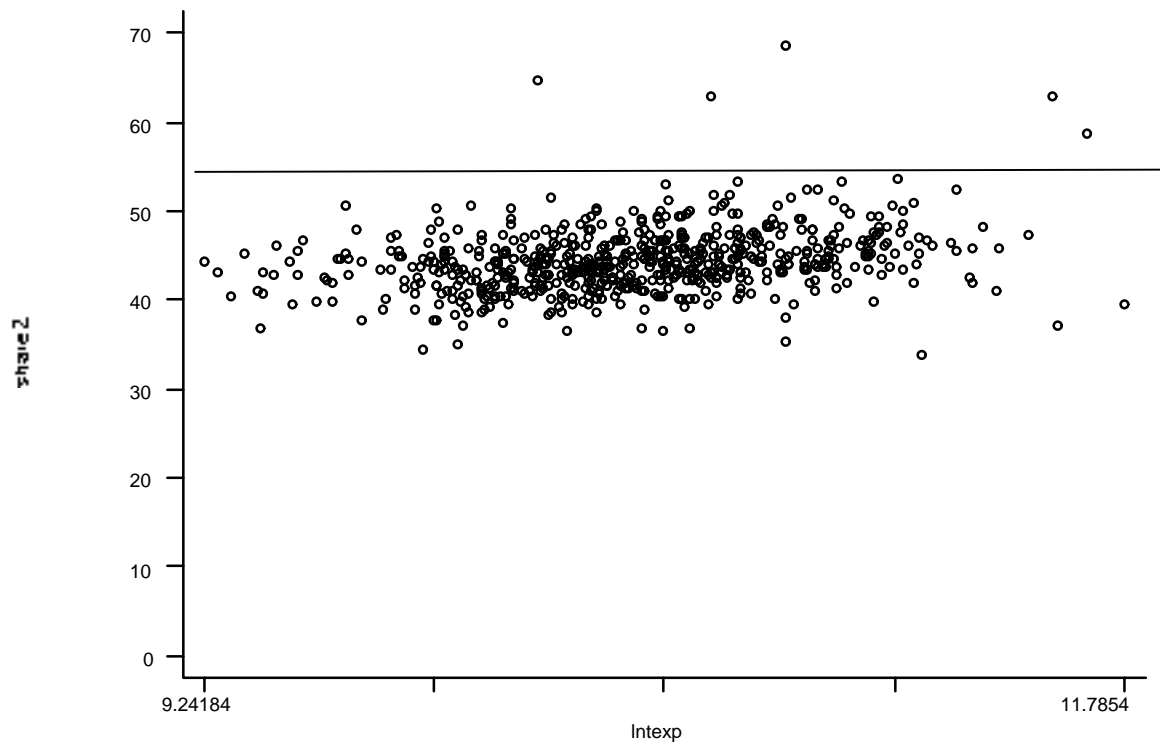**USDA Estimates of the Percentage of Total Spending Devoted to One Child**

Figure 5-4

USDA ESTIMATES OF THE PERCENTAGE OF TOTAL SPENDING DEVOTED TO TWO CHILDREN

As has been noted, implementation of the USDA approach in this study differs from the USDA's actual procedures. In its annual reports, a table is included (Table 11) that reports estimates of the share of family total expenditures devoted to children by several alternative approaches. In the 1999 Annual Report, for example, estimates are presented of 26 percent, 42 percent, and 48 percent for one, two, and three children respectively. While those estimates are consistently lower than the estimates presented in this report, there exist some important differences in the studies that should be taken into account before judging the differences in estimates.

While the USDA report is for 1999, in reality the data for that report are based on the 1990–1992 CEX and indexed for inflation.[50] Differences in samples can have an effect on the estimates as well as on differences in spending patterns. If the standard errors are roughly equal in the two years, however, then these differences are not statistically different.

But other differences could also affect the comparison. For example, the USDA has decided to use quarterly observations instead of the annual approach that was taken in this study. (The impact of this choice is unknown and will be examined at a future date.) A more important factor affecting the two estimates is the definition of total expenditures. The USDA uses a much-wider definition of spending than does this study, and that could be the primary reason for these differences.

Average Engel and Rothbarth Estimates

Using the regression estimates of food share (Exhibit 5-8) and adult clothing equations (Exhibit 5-9), an estimate of the share of family spending devoted to the children can be computed for different numbers and ages of children as well as for specific levels of total spending. Using the average values of these variables, the Engel and Rothbarth allocations to the children can be computed. To compute the level of variation in these estimates due to sampling variability, a bootstrap technique was used. The exact procedure and explanation of the bootstrap is contained in Betson's report.[51]

The Engel method yielded estimates of 30.1 percent, 43.9 percent, and 52 percent for the share of family spending devoted to one, two, and three children respectively. The standard errors of the estimates were 3, 3.1, and 3 percentage points. The null

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[50] The role that inflation plays in the USDA updates is quite perplexing. In the 1995 Annual Report, estimates are much lower than in the 1999 Annual Report. For example, for one child in 1995 the estimate is that 22 percent of family spending is devoted to the child—four percentage points lower than in the 1999 Annual Report. The only difference between the two reports is inflation, since both reports use the same 1990–1992 CEX data. The share of spending to the child could rise if the price of child goods rose faster than general inflation, but this difference is hard to believe.

[51] Betson (1990).

hypothesis that the Engel estimate is different from a per capita allocation for one child cannot be rejected. However, for two and three children, the null hypothesis of equality between the Engel and the per capita allocation approach can be rejected.

The Rothbarth method yielded 25.6 percent, 35.9 percent, and 41.6 percent as estimates of the average share of spending devoted to one, two, and three children. The standard errors of the estimates were 3.7, 3.8, and 3.7 percentage points. While the precision of the Rothbarth estimates was smaller than for the Engel estimates, one can reject the null hypothesis of equality between per capita and Rothbarth estimates for all numbers of children.

The Engel estimates are consistently lower than the USDA estimates; however, they are not statistically different. The Rothbarth estimates are consistently smaller than either the Engel or the USDA estimates. While for one child the three estimates are not statistically different, for two and three children the Rothbarth estimates are statistically different from both the Engel and the USDA estimates.

Comparing the Current Estimates to Estimates From the 1980s

In Dr. David Betson's 1990 study on the cost of raising children, he estimated identical Engel and Rothbarth models using CEX data from 1980 to 1986. This earlier analysis showed that the Engel approach was almost identical to a per capita allocation. Further, Betson found that the Rothbarth approach produced significantly lower estimates than the Engel approach. To hold real purchasing constant between the samples, Betson recomputed the average estimated share of family expenditures devoted to children at the same real total expenditures in 1983 dollars as was average total spending in the current sample. Exhibit 5-10 provides a direct comparison of the current estimates with the previous estimates along with their respective standard errors.

Exhibit 5-10
Estimates of the Allocation of Spending on Children
(Standard errors are in parentheses.)

| | Number of Children | | | | | |
	1		2		3	
Per Capita	33.3%	(0.0)	50.0%	(0.0)	60.0%	(0.0)
1996–1997 CEX						
USDA	30.3%	(3.7)	44.9%	(3.4)	53.5%	(3.3)
Engel	30.1%	(3.0)	43.9%	(3.1)	52.0%	(3.0)
Rothbarth	25.6%	(3.7)	35.9%	(3.8)	41.6%	(3.7)
1980–1986 CEX						
Engel	33.0%	(1.4)	49.1%	(1.4)	59.3%	(1.2)
Rothbarth	24.2%	(1.7)	34.2%	(1.8)	39.2%	(1.9)

A comparison of the point estimates suggests that the Engel estimates are lower today than they were in the 1980s, while the Rothbarth estimates have become larger. However, these differences could be the result of differences in the sample and not differences in parental spending patterns. Taking into account the standard error of the estimates due to sampling variability, it is evident that only in the case of the Engel method for three children has there been any significant change in the share of spending devoted to children. In all other cases, the shift is not statistically significant.

Another perspective from which to examine the robustness of the estimates is to ask how much additional spending will the family make if additional children are added to the family. For example, if a per capita allocation is used, then 33 percent of the family's spending would be devoted to the children if only one child was present. But if two children were present, then 50 percent of the family's spending would be devoted to the children. It can be inferred that the family would spend 50 percent more on their children due to the presence of the second child ($100*(50-33.3)/33.3 = 50.2$). If a third child is added, then 60 percent of the family's spending would be allocated to all three children and the marginal impact of the third child would be an additional 20 percent more in spending. Exhibit 5-11 presents the marginal costs of the second and third child for the various estimates.

Exhibit 5-11
Additional Costs of the Second and Third Children

| | Increase in Child Spending Due to: | |
	Second Child	Third Child
Per Capita	50%	20%
1996–1997 CEX		
USDA	48%	19%
Engel	46%	18%
Rothbarth	40%	16%
1980–1986 CEX		
Engel	49%	21%
Rothbarth	41%	13%

The USDA and Engel estimates from the 1980s are very similar to what is implied by a per capita allocation of spending to individual family members. While the more-recent Engel estimates imply smaller marginal costs, they are still close to per capita allocations. Only the Rothbarth method produces estimates that imply a substantially lower cost of each additional child.

Effect of Total Spending

Figures 5-5 through 5-7 depict how the share of family expenditures devoted to children varies with the level of total family spending. The USDA (Figure 5-5) and the Engel (Figure 5-6) methods both produce estimates of parental sharing that increase with total spending. It should be noted that neither increase is statistically significant.

In the previous chapter, an explanation was provided for why the USDA approach produced these results. It was found that the allocation to children would rise because of the relatively large income share elasticity of food. The reason the Engel method has yielded the same outcome may also be the result of this relatively large elasticity. However, that is only a hypothesis at this time. It should be noted that in Betson's 1990 study, the Engel estimates were constant over the relevant ranges of total spending.

Figure 5-5
USDA Estimates of Parental Sharing by Total Expenditures
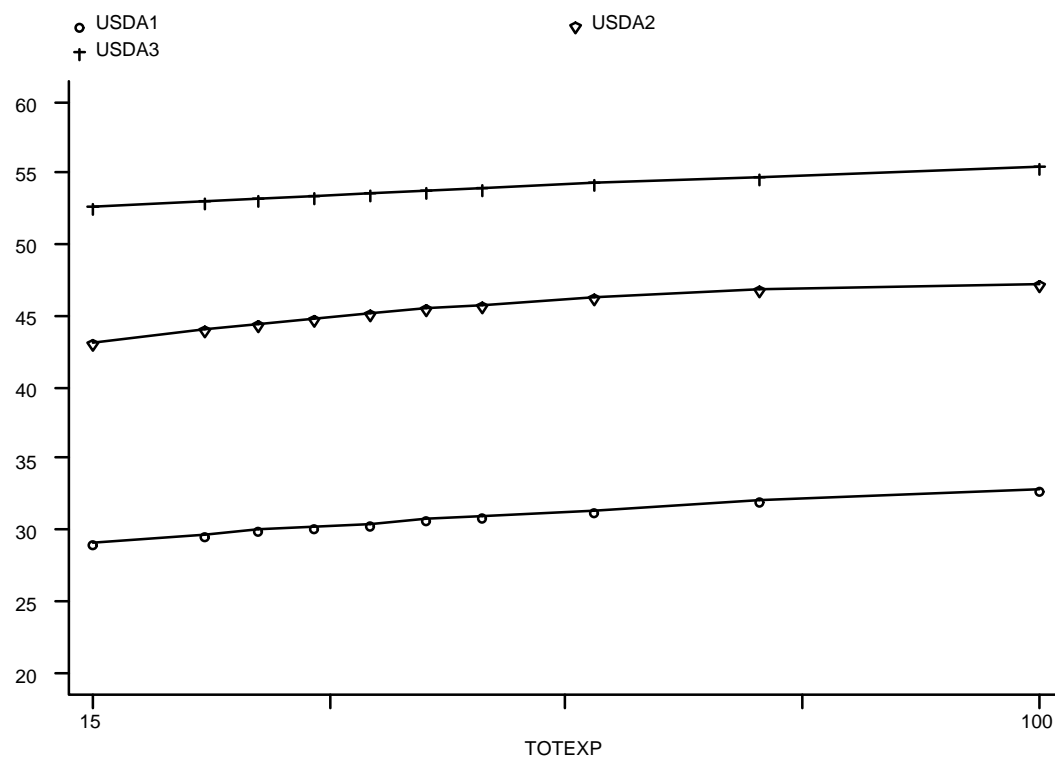**for One, Two, and Three Children**
(in $1,000)

Figure 5-6
Engel Estimates of Parental Sharing by Total Expenditures
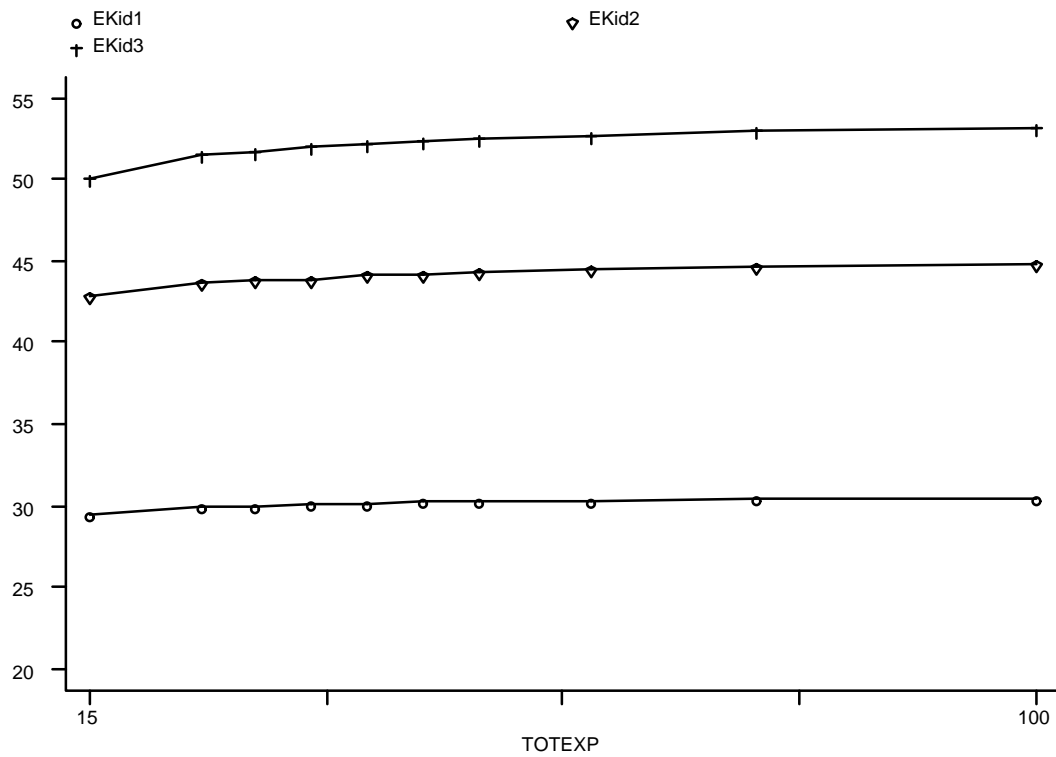**for One, Two, and Three Children**
(in $1,000)

Figure 5-7
Rothbarth Estimates of Parental Sharing by Total Expenditures
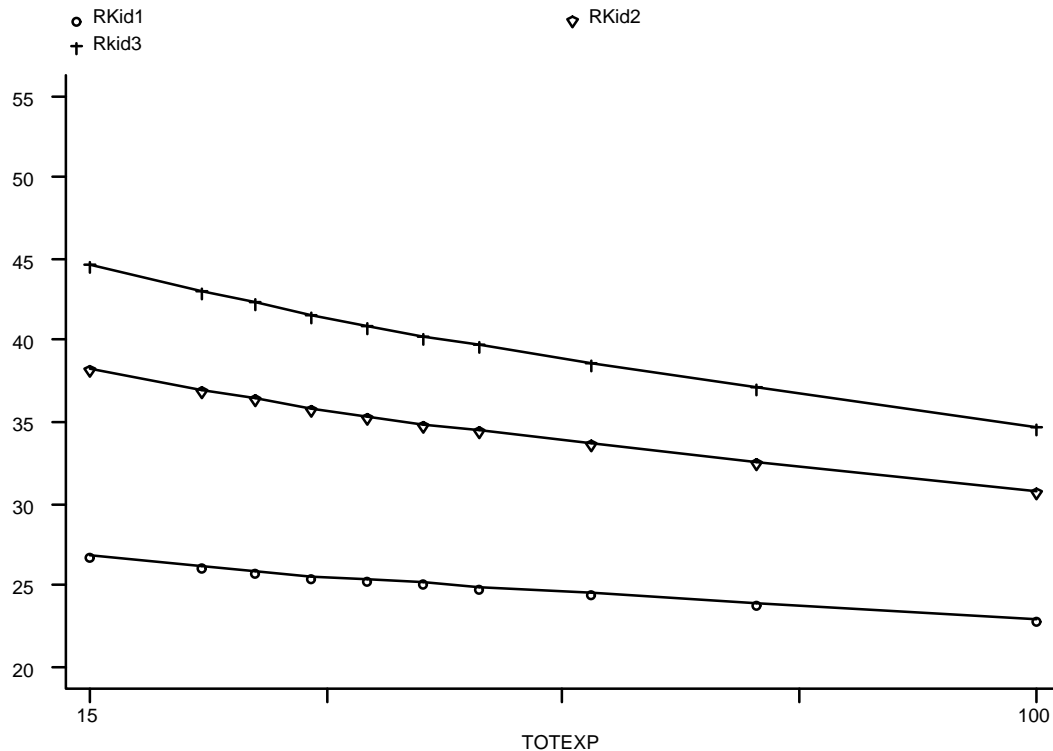**for One, Two, and Three Children**
(in $1,000)

Figure 5-7 shows the results from the Rothbarth approach, which produces estimates that steadily decline with total spending. This finding is consistent with the earlier study, which found a constant reduction in the share of total spending that was devoted to the children as total family spending increased.

Effect of the Age of the Child

As a child ages, it might be expected that the consumption needs of the child would increase. Given the increase in needs, the parents will have to devote larger proportions of their spending to their children. To directly compare estimates from different methods and different data sets, childhood was divided into three equal time periods: 0–5 years, 6–11 years, and 12–17 years. Then, drawing upon various studies that were relatively comparable, the estimated child expenditures for each age group were expressed as a percentage of the costs of a middle-age child (6–11

years old). A number less than 100 implies that, relative to a middle-age child, less is spent on that child. Conversely, a number over 100 implies that relatively more is spent. These calculations are presented in Exhibit 5-12.

Exhibit 5-12
Relative Costs of Younger and Older Children

| | Costs Relative to a Child 6 to 11 Years Old | | | Older Child |
	Young Child (0–5)	Middle Child (6–11)	Old Child (12–17)	Costs Relative to Youngest Child
USDA Method				
1999 Annual Report	99	100	109	110
1996–1997 CEX Data (Betson)	98	100	103	105
Engel				
1972–1973 CEX (Espenshade)	72	100	106	147
1980–1986 CEX (Betson)	82	100	116	141
1996–1997 CEX (Betson)	71	100	108	152
Relative Food Needs				
Moderate-Cost Food Plan	67	100	116	172
Rothbarth				
1980–1986 CEX (Betson)	97	100	95	98
1996–1997 CEX (Betson)	95	100	87	92

Source: calculations by author

The USDA and Engel approaches produce the anticipated age gradient. However, the age gradient may not be as steep as would be expected in the USDA estimates. Older children from the USDA's 1999 Annual Report are estimated to cost 10 percent more than the youngest child, while the USDA estimates from this study imply that older children are only 5 percent more costly. The Engel estimates consistently suggest a steeper age gradient—older children costing 47 percent, 41 percent, or 52 percent more than the youngest child. An interesting comparison is with the relative food needs of children implicit in the Moderate-Cost Food Plans of the USDA. While the Engel estimates create very similar age cost profiles, the food plan suggests a much steeper gradient. Here, older children are 72 percent more expensive than the youngest child.

While the present Engel study produces the steepest increases in cost with age, some caution must be given to this finding. The present study has produced the steepest gradient due to the relatively low costs of young children. Testing the equality of the estimated coefficients on the variables reflecting the age composition of the children (K02, K35, K612, K1315, and K1617), it is found that only the effect of the very youngest children (K02) is statistically different from the other age groups. It can be

inferred from this test that in the Engel estimates the costs of older children are not statistically different than the costs of middle-age children and that the relative cost of young children is overstated.

The Rothbarth approach does not produce the anticipated increase of child costs with the age of the child. This is a result of a problem in the CEX public use data. While the BLS assigns to individual family members the purchase of clothing, the public use file only records whether the item was purchased for an individual who was under or over 16 years old. The regression results presented in Exhibit 5-9 show that the coefficient reflecting the proportion of children 16 and 17 years old is opposite in sign to all of the other coefficients on children age categories. Testing the equality of the coefficients on the variables reflecting the age composition, it is found that only the coefficient on the very oldest category (K1617) is statistically different from the others. This suggests that the Rothbarth age profile is not statistically different from a constant cost for all ages.

Other Recent Studies

Most of the empirical research has not focused on the economic cost of raising children, but rather on the closely related topic of equivalence scales. Equivalence scales relate the differential costs to families of different compositions to maintain the same level of well-being as some reference family type. Usually the reference family is the single individual. However, it should be understood that the concept of equivalence scales is central to indirect approaches such as the Engel and Rothbarth methods. If equivalence scales could be determined for families of all different compositions, then these scales could be used to allocate expenditures to children as well as to adults. Unfortunately, all of the recent work on equivalence scales fails to differentiate children from adults. Hence, it is impossible for these studies to be informative about how to allocate family spending to the children unless the needs of children are to be counted as equivalent to those of adults.

A study that explicitly examined the cost of raising children is a report prepared by James Shockey for the Judicial Council of Arizona.[52] The purpose of his study was to analyze the CEX data from 1991 (the most recent data available at the time of his study) and to closely examine Betson's earlier work. Shockey only estimated the Engel method. His estimates for one, two, and three children were 33 percent, 49 percent, and 57 percent. These estimates differ only slightly from Betson's 1980–1986 estimates for three children (59 percent). For one and two children, the two sets of estimates are identical.

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[52] James Shockey, "Determining the Cost of Raising Children in Nonintact Arizona Households," final report to the Judicial Council of Arizona, Phoenix, Arizona (1995).

Shockey also provides a valuable test of the stability of the Engel estimates. Instead of pooling the data across the years, he estimated the Engel model for each of the odd years between 1981 and 1991. His annual estimates for two children are 48 percent, 51 percent, 52 percent, 50 percent, 49 percent, and 49 percent. Although he does not compute standard errors for the estimates, it does appear that the pooling of data across the years does not affect the empirical estimates.

Although the paper by Conniffe[53] is not empirical, it does present a strong theoretical argument for equivalence scales to decline as total spending (income) rises. This argument would suggest that the constancy of the USDA and Engel costs of children with respect to changes in total spending should be viewed with suspicion and provides another positive argument for the Rothbarth estimates.

CONCLUSIONS

This chapter has examined three alternative methods of determining the amount of parental spending on children. Each method has its strengths and its weaknesses. The USDA approach is direct and hence more transparent than either the Engel or Rothbarth methods. However, with simplicity comes a reliance on assumptions that are certain to be wrong. The Engel and Rothbarth methods require other assumptions to identify how much more or less spending families of different compositions need to maintain a given standard of living. Some have used the results of Deaton and Muellbauer[54] to justify the use of both the Engel and Rothbarth estimates as upper and lower bounds for the estimates. However, Deaton and Paxson have shown that the assumptions needed by the Engel method are most certainly wrong and are contradicted by the data.

What does this mean? It can be argued that of all the approaches examined in this research the Rothbarth method is the least objectionable. While the assumptions needed to identify this approach are strong, there is no empirical evidence that they are wrong. Some people might object to whether adult clothing, which constitutes less than 5 percent of a family's total spending, provides a reliable basis to estimate the cost of raising children. But given the precision with which estimations can be made on how family size, composition, and total spending affect the family's decision of how much clothing to purchase, the cost of children can be estimated with a degree of precision comparable to other methods. The only significant problem with this approach lies not with the method, but with the data. The BLS should be encouraged to allocate adult clothing purchases based on an age of 18 years and not 16 years as is the current practice.

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[53] Denis Conniffe, "The Non-Constancy of Equivalence Scales" (1992) 38(4) *Review of Income and Wealth* 429–443.

[54] Angus Deaton and John Muellbauer, "On Measuring Child Costs" (1986) 94(2) *Journal of Political Economy* 720–744.

The findings presented in this report suggest that parental spending on children has not significantly risen or declined since the 1980s. While the Rothbarth estimates have shown a slight increase, these differences could be attributed to sampling variability as well as to true changes in spending patterns. The tests that were performed in this research cannot rule out the possibility that differences in samples have created the observed differences in parental spending.

A natural question to ask is whether we should continue to use the estimates from Betson's earlier study or to move toward the estimates from the current research. One clear argument in favor of adopting the present estimates is that they reflect more recent economic data. However, given that the possibility cannot be ruled out that any differences in estimates are the result of sampling variability, it is not possible to be convinced that these recent estimates are better. The much-higher level of precision that the earlier estimates have relative to the more current ones should be pointed out. Given that the changes are not significant, people should use the older estimates until the precision of the current estimates can be improved.

Tests for statistical significance of differences depend upon the sample size. The current study, by employing only two years of CEX data, contains roughly one-third of the number of observations available in the previous study. In the next phase of work, two more years of data will be added to the sample. This increase in sample size should reduce the standard errors of the estimates of the cost of children and permit a sounder test of whether spending patterns have indeed changed from the 1980s. The results of this work, as well as the analysis of the spending in single-parent families, will be included in the final version of the report.